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Costs, Field Survival, and Yields of Four Methods of Handling Tomato Transplants

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Costs, Field Survival, and Yields of Four Methods of Handling Tomato Transplants

by L. A. Risse and T. Moffitt[1]

ABSTRACT

Four methods of handling tomato transplants were tested: hand harvesting, bundling, and shed packing; hand harvesting, bundling, and field packing; hand harvesting and loose field packing; and machine harvesting and loose field packing. Whether harvested by hand or machine, tomato transplants packed loose in the field cost less to pack and ship than hand-harvested and bundled plants, whether shed or field packed, and their field survival rate and yield is the same or better. Machine-harvested, field-packed, loose plants showed a significantly higher field survival rate (92.7 percent) than plants handled by the other methods; their yield was also the highest (24.0 tons per acre), significantly higher than the yield from bundled plants. Costs for harvesting, packing, and shipping 1,000 plants (excluding capital investment costs) by each of the four methods were $2.70, $2.58, $2.27, and $2.23, respectively. If all 700 million of the transplants produced in southern Georgia for shipping to northern growing areas were packed loose in the field (whether machine or hand harvested), the average savings of approximately 40 cents per 1,000 plants would total $280,000 annually. Index terms: field survival rate, harvesting costs, mechanization, packing tomato transplants, packing costs, shipping tomato transplants, shipping costs, tomato plants, tomato transplants, tomato yields.

INTRODUCTION

Over 700 million tomato transplants (plants) are produced in southern Georgia each spring for shipment to northern growing areas (Georgia Department of Agriculture 1979). Because of the scarcity and high cost of labor, tomato transplant producers are becoming increasingly interested in mechanizing the harvesting and transplanting processes. This will not only require the abundant production of uniform-sized plants on land suitable for mechanical harvesters (Jaworski 1967, Williamson et al. 1976, Williamson and Jaworski 1979), but also changes in the way plants are packed and shipped.

The old method of packing tomato plants was to harvest by hand and pack in a shed by wrapping bundles of plants in wet moss and paper (Miller et al. 1949), but some innovations have proven successful. Satisfactory results have been obtained by shipping bare-root plants in perforated polyethylene bags or hamper liners (Borders et al. 1955); in perforated, polyethylene-lined, keystone-shaped, wirebound crates (Moran et al. 1962); and in wirebound crates without polyethylene liners that are shipped and temporarily stored at 55° F (12.8° C) for 6 to 10 days

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(Risse and Moffitt 1971).[2] A mechanical plant harvester has been designed, developed, and tested with satisfactory results (Williamson et al. 1976), and several growers have developed mechanical harvesters for use in Georgia.

By 1978, most Georgia tomato plants were hand harvested, tied into bundles of about 50 plants, and the bundles placed in wirebound crates (either in the field or at the packing shed). But many growers in northern producing areas reported string damage to some plants and some difficulty separating individual plants from the bundles. This study was initiated to determine (1) the amount of damage to plants; (2) the effect hand and machine harvesting and packing plants loose rather than in bundles had on field survival and yield; (3) the temperature of plants during shipment; and (4) the cost of harvesting and packing loose plants.

PROCEDURES

Field Studies

In 1978, five field studies were conducted to evaluate four combinations of methods of harvesting and packing tomato transplants (fig. 1): (1) hand harvesting, bundling, and shed packing; (2) hand harvesting, bundling, and field packing; (3) hand harvesting, and loose field packing; and (4) machine harvesting and loose field packing. The plants used in these studies were field grown near Tifton, Ga. under commercial practices and packed in keystone-shaped, wirebound crates that were 18½ inches long, 10 to 12 inches wide, and 13 inches high (inside dimensions). All plants were harvested and packed by commercial growers.

Hand-harvested, bundled, shed-packed (treatment 1) plants were harvested when 8 to 12 inches high. They were pulled by hand and tied with string in bundles of 50 to 55 plants. The bundles were put into burlap bags or pallet bins and hauled to the packing shed, where the bags or bins were dumped and the bundles placed on a conveyor. Depending on the size of the plants, 12 to 20 bundles were placed in keystone-shaped, wirebound crates and the crates stacked horizontally in ventilated or refrigerated trucks.

Hand-harvested, bundled, field-packed (treatment 2) plants were harvested and packed in the same manner as treatment 1 plants, except that once bundled, the plants were packed directly into the crate in the field. The crates were then placed on wagons, field trucks, or pallets to be hauled to a truck for loading and shipment. The trucks were usually loaded in the field, but a few growers hauled packed crates to a central loading area (usually their packing shed).

[2]The recommended temperature for shipping and storing tomato plants is between 50° and 60° F (10.0° to 15.6° C) (Jaworski et al. 1967, Lutz and Hardenburg 1968).

Figure 1.—Tomato transplants: (A) hand harvested, bundled, shed packed; (B) hand harvested, bundled, field packed; (C) hand harvested, field packed, loose; and (D) machine harvested, field packed, loose.

Hand-harvested, field-packed, loose (treatment 3) plants were harvested the same way as treatment 1 and 2 plants but the pullers did not bundle the plants. After the plants were pulled, they were packed loose into the crate (fig. 2). The packed crates were then stacked on wagons, field trucks, or pallets, and moved to the loading area in the field or at the grower's packing shed.

Because bundles do not nest as well as the loose plants, more plants are usually packed per crate when packed loose than in bundles. Pullers try to pack the same number of plants in each crate, but because plant sizes vary, the number of plants per crate varies also. To determine the number of plants in a shipment, growers count each plant in a random sample of crates or weigh a random sample of crates and count each plant in a 2- or 3-pound sample from each crate.

Treatment 4 plants were harvested by machine (fig. 3) and packed loose in the field. The self-propelled harvesting machine used in this study harvested two rows of plants at a time by loosening the soil under the row of plants, and lifting the plants by belts to the top of the machine. As the belts lifted the plants, the soil was shaken from the roots. Once the plants reached the top of the harvester, they were laid down on an accumulating belt from which the packer lifted plants into the crates. After a crate was filled and closed, it was stacked on a pallet. At the end of the row, pallets of full crates were removed and empty pallets were put on the harvester. The filled pallets were then moved to a loading area and loaded on a truck for shipment.

The production practices used after transplanting were commercial field practices. Grower studies 1 to 3 were conducted near Leamington, Ontario, Canada; study 4 was conducted at Leipsic, Ohio; and study 5 at Green Springs, Ohio.

In grower studies 1 to 3, crates of plants were selected at random from each treatment for transplanting. Each of three growers planted 1-acre plots of plants from each treatment. We recorded the number of marketable,[3] small, and damaged plants in two bundles of plants or a handful of loose plants (about 100 plants) from each of five crates chosen at random from each treatment. About 1 month after planting, field survival of transplants was recorded from five rows (about 500 plants per row) chosen at random from each treatment. Fruit yield was recorded at harvest for each of the 1-acre plots. Each grower made three harvests.

In grower studies 4 and 5, bundles or handfuls of loose plants were removed from the centers of each crate, and the number of marketable, small, and damaged plants was recorded. Plantings in both these studies followed a randomized-block design with four replications. Field survival was recorded about 1 month after planting and tomato yield was recorded at harvest. Two harvests were made in these studies. Plant condition, field survival and yield data were tested by analysis of variance and Duncan's multiple-range test.

[3]Marketable plants as defined by the Georgia Department of Agriculture (1979).

FIGURE 2.—Hand harvesting and field packing of loose plants.

FIGURE 3.—Machine harvesting and field packing of loose plants.

In grower studies 1 and 2, we used the variety 'New Yorker'. When harvested (on May 10, 1978), the plants were large (10 to 12 inches in height) and were packed about 1,050 per crate. The plants arrived in Canada on May 12, but due to inclement weather, they were placed in storage at about 55° F until planting (on May 17 by grower 1 and May 21 by grower 2).

The variety 'C-28' was used in grower studies 3 to 5. When harvested (on May 18), the plants were large (10 to 12 inches in height) and packed about 1,100 per crate. The plants for grower 3 arrived in Canada and were planted on May 20. For growers 4 and 5, the plants arrived on May 20, but because of wet field conditions, were stored at about 55° F until planting on May 22 and 25, respectively.

Temperature Studies

Temperature studies were conducted to see if loose-packed plants cooled as satisfactorily as bundled plants. The average temperature of two truckloads of bundled, shed-packed plants and five of loose plants was recorded during transit to Ohio and Leamington, Ontario, in 1978 and 1979. An additional truckload of plants that were overpacked was compared to standard (normally packed) plants in transit from Georgia to Ohio. In each test, temperatures were recorded at selected locations (18 among plants and 6 in the air) throughout each truck every 30 minutes from the time of loading until unloading. Thermistor-type sensors attached to a battery-operated recorder were inserted in the center of the crates (near the plants' leaf line in the center of a bundle or the center of the crate of loose plants).

A stationary cooling and warmup test was also conducted with four boxes each of bundled and loose plants that were field packed in Tifton, Ga., and transported to Orlando, Fla. Upon arrival in Orlando, the boxes were placed in cold storage (55° F) for 15 hours, removed for eight hours and then put back into cold storage. Two thermistor-type sensors in the center of each crate recorded plant temperatures and two recorded air temperatures.

Cost Studies

In 1978 and 1979, studies were conducted to compare the cost of commercial packing and shipping of bundled and loose-packed plants. Because machine-harvested, field-packed, loose plants were harvested and packed only on a limited scale, some of the cost data are only estimates. Direct labor requirements for harvesting, packing, and loading were obtained from time studies in several packing sheds and field operations. Labor costs were calculated at a wage rate of $3 per hour, and the cost of equipment, supervision, and overhead was not included. Shipping costs are charged per crate regardless of the number of plants in each, and since weight is seldom a factor, trucks are usually loaded to full volume capacity. Transport charges were calculated from Georgia to Ohio.

Table 1.—Percentage of marketable plants reaching northern growers, 1978[1]

Grower study	Treatment 1[2]	Treatment 2[3]	Treatment 3[4]	Treatment 4[5]
1	84.4ab	86.6a	87.5a	74.5b
2	86.3b	87.9b	88.3b	91.9a
3	86.9ab	83.8b	83.3b	92.8a
Average	85.9a	86.1a	86.4a	86.4a
4	76.8a	77.7a	72.3a	77.6a
5	80.3a	82.7a	82.9a	86.6a
Average	78.6a	80.2a	77.6a	82.1a
Grand average	82.9a	83.7a	82.9a	84.7a

[1]Within rows, percentages followed by the same letter are not significantly different (using Duncan's multiple-range test at the 5-percent level).
[2]Hand harvest, bundle, shed pack.
[3]Hand harvest, bundle, field pack.
[4]Hand harvest, field pack, loose.
[5]Machine harvest, field pack, loose.

RESULTS

Field Studies

Marketable plants.—In individual grower studies there were some significant differences among treatments in the percentage of marketable plants that reached northern growers, but the average of all five grower studies showed no significant differences between any treatments (table 1). In grower study 1, the percentage of marketable plants was the lowest for treatment 4 plants (74.5 percent), but this was caused by a very high percentage of small plants in one crate. Otherwise, the percentage of marketable plants that were machine harvested and packed loose in the field was either equal to or higher than that for other treatments. This is probably caused by the mechanical transplant harvester used; its lifting belt dropped some of the smaller plants, eliminating them.

Small plants.—Three grower studies showed some significant differences among treatments in the percentage of small plants (less than 6 inches) that were packed, but the average of all grower studies showed no significant differences between any of the treatments (table 2).

Damaged plants.—No grower studies showed significant differences between treatments in the percentage of damaged (broken or severaly bruised) plants (table 3), a finding that agrees with earlier research (Williamson et al. 1976). Many hand-harvested plants showed minor injuries to the stems of the plants, but these were not counted as damaged plants since these plants usually survive.

Plant survival.—In all grower studies, the percentage of plant survival was highest for machine-harvested, field-packed, loose plants; the average (92.7 percent) was significantly higher than that of the other three treatments (table 4). Even when plants went 7 days between harvest and transplanting (in grower studies 1 and 4) plant survival was above 95 percent. When this interval was as high as 11 days (in grower study 2), plant survival dropped to 76.4 percent, but was still higher than that of the other harvesting and packing methods. The reasons machine-harvested plants survived best are (1) there was less damage to the plant during pulling and handling, (2) more roots remained intact on the plant, and (3) the amount of plant dessication was reduced because less time was spent handling plants and moving them from the soil to the shipping crate and to the refrigerated truck.

Hand-harvested, bundled, shed-packed plants had the lowest average survival (80.4 percent). In individual grower studies this treatment usually had the lowest (in some cases significantly lower) survival percentage among hand-harvested packing methods.

Yields.—In all grower studies, the marketable yield of tomatoes was highest or second highest for machine-harvested, field-packed, loose plants (table 5); the average (24.0 tons per acre) was significantly higher than that of hand-harvested, bundled plants (treatments 1 and 2), but was not

(*Continued on page 8.*)

Table 2.—Percentage of small plants reaching northern growers, 1978[1]

Grower study	Treatment 1[2]	Treatment 2[3]	Treatment 3[4]	Treatment 4[5]
1	11.2b	11.2b	9.3b	19.1a
2	11.4a	9.5a	9.7a	6.5b
3	13.1a	15.7a	16.7a	6.9b
Average	11.9a	12.1a	11.9a	10.8a
4	23.2a	22.3a	27.0a	24.0a
5	18.9a	16.3a	16.4a	13.4a
Average	21.1a	19.3a	21.7a	17.9a
Grand average	15.6a	15.0a	15.8a	13.7a

[1] Within rows, percentages followed by the same letter are not significantly different (using Duncan's multiple-range test at the 5-percent level).

[2] Hand harvest, bundle, shed pack.

[3] Hand harvest, bundle, field pack.

[4] Hand harvest, field pack, loose.

[5] Machine harvest, field pack, loose.

Table 3.—Percentage of damaged plants reaching northern growers, 1978[1]

Grower study	Treatment 1[2]	Treatment 2[3]	Treatment 3[4]	Treatment 4[5]
1	4.4a	2.2a	3.2a	6.4a
2	2.3a	2.6a	2.0a	1.6a
3	.0a	.5a	.0a	.3a
Average	2.2a	1.8a	1.7a	2.8a
4	.0a	.0a	.7a	.0a
5	.8a	1.0a	.7a	.0a
Average	.4a	.5a	.7a	.0a
Grand average	.5a	.5a	.5a	.6a

[1] Within rows, percentages followed by the same letter are not significantly different (using Duncan's multiple-range test at the 5-percent level).
[2] Hand harvest, bundle, shed pack.
[3] Hand harvest, bundle, field pack.
[4] Hand harvest, field pack, loose.
[5] Machine harvest, field pack, loose.

Table 4.—Survival percentage of test plants, 1978[1]

Grower study	Number of days[2]	Treatment 1[3]	Treatment 2[4]	Treatment 3[5]	Treatment 4[6]
1	7	75.7c	83.8b	79.2bc	96.2a
2	11	62.9a	70.3a	66.5a	76.4a
3	2	97.5a	98.1a	97.0a	98.1a
Average	...	78.7c	84.1b	80.9bc	90.2a
4	7	82.6b	89.1b	83.7b	95.6a
5	4	83.3b	90.3a	93.8a	97.2a
Average	...	83.0c	89.7b	88.8b	96.4a
Grand average	...	80.4b	86.3b	84.0b	92.7a

[1] Within rows, percentages followed by the same letter are not significantly different (using Duncan's multiple-range test at the 5-percent level).
[2] Number of days between harvesting and packing of plants in Georgia and planting in the north.
[3] Hand harvest, bundle, shed pack.
[4] Hand harvest, bundle, field pack.
[5] Hand harvest, field pack, loose.
[6] Machine harvest, field pack, loose.

Table 5.—Yield of marketable tomatoes (tons per acre) from test plants, 1978[1]

Grower study	Treatment 1[2]	Treatment 2[3]	Treatment 3[4]	Treatment 4[5]
1[6]	14.2	10.2	17.4	21.9
2[6]	11.5	8.9	15.6	18.4
3[6]	19.6	19.8	21.6	21.2
Average	15.1bc	13.0c	18.2ab	20.5a
4	18.9b	20.8ab	22.3ab	23.9a
5	30.9a	34.5a	32.7a	34.6a
Average	24.9b	27.7ab	27.5ab	29.3a
Grand average	19.0bc	17.1c	21.9ab	24.0a

[1] Within rows, values followed by the same letter are not significantly different (using Duncan's multiple-range test at the 5-percent level).
[2] Hand harvest, bundle, shed pack.
[3] Hand harvest, bundle, field pack.
[4] Hand harvest, field pack, loose.
[5] Machine harvest field pack, loose.
[6] Since there was no replication, these grower studies could not be statistically analyzed.

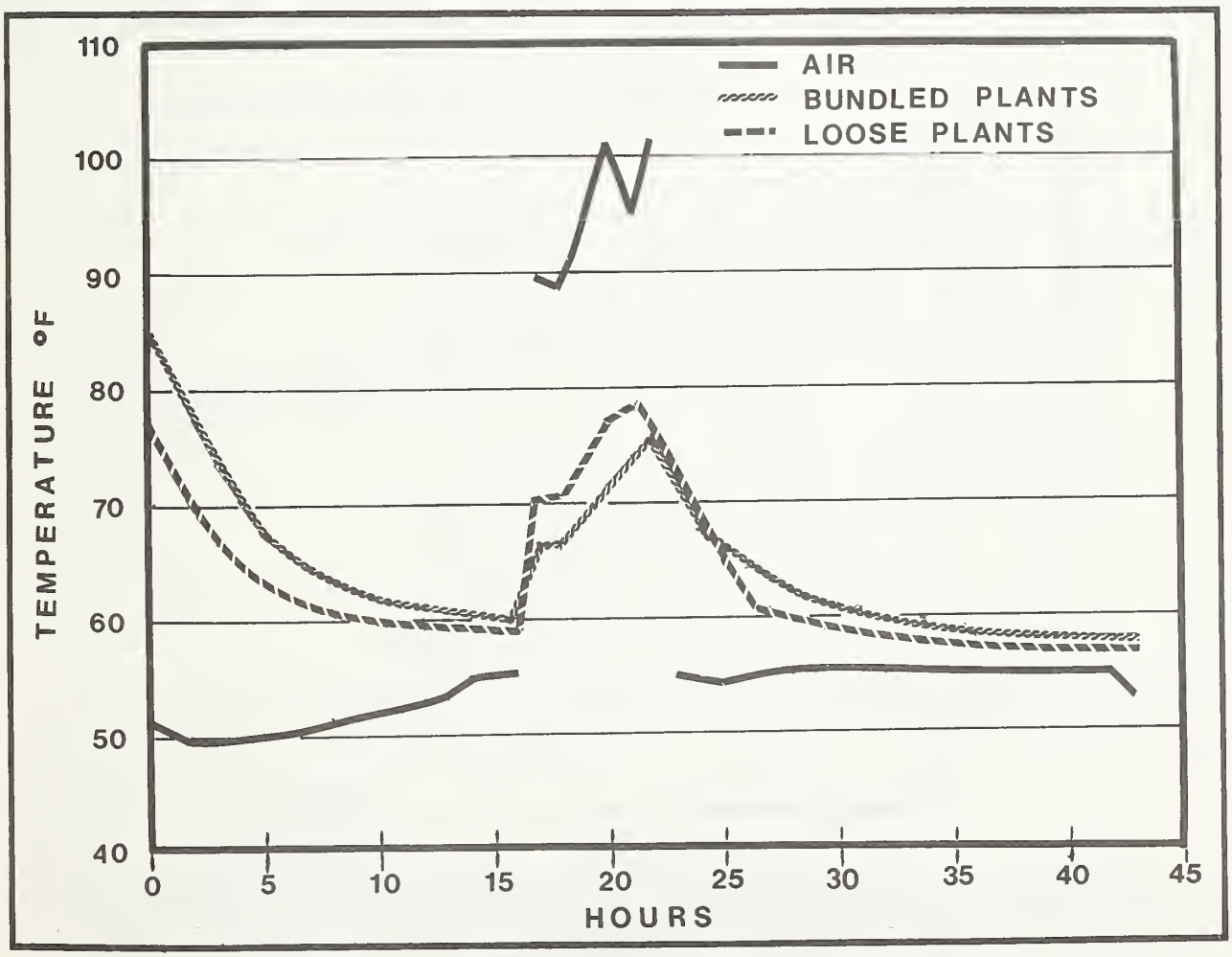

FIGURE 4.—Simulated storage test: average temperatures for bundled and loose field-packed plants and air temperature.

statistically different than yields of hand-harvested, field-packed, loose plants. In individual grower studies, hand-harvested, bundled, plants usually had lower yields than the loose-packed plants (whether hand or machine harvested). These findings again corroborate those of Williamson et al. (1976), indicating that machine harvesting and loose packing do not reduce tomato yields.

Temperatures

In the simulated storage test, the temperature of loose plants (about 1,150 plants per crate) changed faster than that of field-packed, bundled plants (about 1,050 plants per crate) (fig. 4). The separated loose plants cool faster than plants in bundles as long as they are not overpacked. There was usually a 2° to 4° F difference in the temperatures of bundled and loose plants, and loose plants were 2° F cooler at the end of each cooling period.

Plants in both the two bundled, shed-packed truck shipments and the five loose, field-packed shipments cooled at about the same rate (table 6). The average temperature of the bundled, shed-packed plants cooled from 85.2° to 63.2° F in 24 hours of transit, and the loose, field-packed plants from 80.6° to 58.4° F.

The top and rear of the load cooled most rapidly. Loose plants that were overpacked (1,200 to 1,500 plants per crate) cooled more slowly than normally packed (standard) plants (1,100 per crate) (fig. 5). Plants harvested when wet with early morning dew or immediately after rains (when soil was difficult to remove from the roots) cooled more slowly than plants packed under normal (dry) conditions.

Costs

Packaging materials.—The only packaging material used to pack plants, other than the wirebound shipping crate, is string to tie the bundles of plants in treatments 1 and 2. The string to bundle one crate of plants (1,000 plants

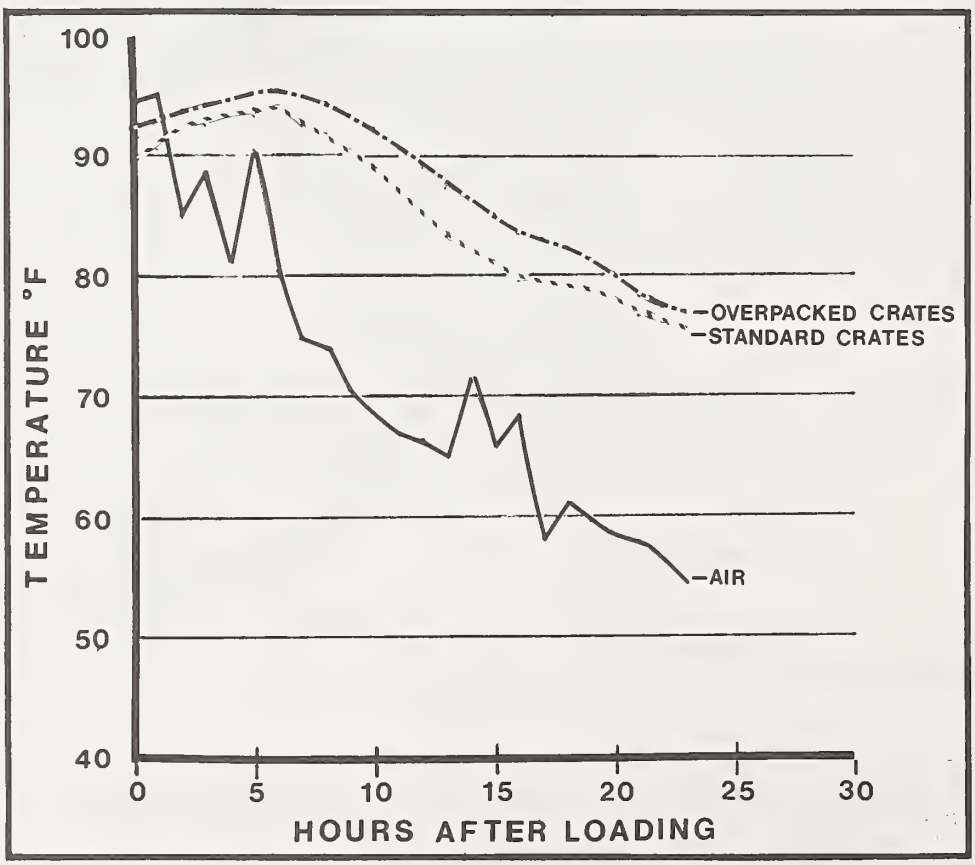

Figure 5.—Average plant temperature in overpacked and normally packed (standard) crates of field-packed, loose plants during shipment to Ohio, 1978.

or 20 bundles) costs about 4.1 cents. More loose-packed plants can be packed per crate (1,100) because bundles of plants do not nest as easily as loose-packed plants. Each wirebound crate costs 82 cents.

Direct labor costs.—Direct labor cost per 1,000 plants for harvesting, packing, and loading was 52.25 cents for hand-harvested, bundled, shed-packed plants; 39.95 cents for hand-harvested, bundled, field-packed plants; 32.25 cents for hand-harvested, loose, field-packed plants; and 27.95 cents for machine-harvested, loose, field-packed plants (table 7). Most additional costs for the bundled, shed-packed plants were caused by the extra labor required to fill, load, and dump bags or pallet boxes of plants for packing in the shed. Additional labor was also required to bundle and tie plants.

Machine-harvested, field-packed, loose plants required less labor because the actual pulling was done by the mechanical harvester. Some mechanical harvesters put the plants directly into the crate, and save even more labor. The cost of assembling, closing, and stacking crates was higher for machine-harvested, field-packed, loose plants than for the same operation in other treatments because of the speed of the mechanical harvester.

Table 6.—Average plant temperatures (° F) of shipments of bundled, shed-packed plants and field-packed, loose plants shipped from Georgia to Ohio and Ontario, May 1978 and 1979[1]

Hours in transit	Bundled, shed packed	Loose, field packed
0	85.2	80.6
4	82.2	80.3
8	76.7	77.6
12	73.8	73.2
16	69.6	68.2
20	66.7	64.7
24	63.2	58.4

[1]2 truckloads of bundled, shed-packed plants and five of field-packed, loose plants. All mechanical refrigerated trucks with thermostat set at 55° F, front vents open during nighttime hours and rear vents open all the time.

Table 7.—Direct labor requirements (man-minutes) and costs (cents) to harvest, pack, and load 1,000 tomato transplants, 1978-79[1]

Operation	Treatment 1[2]		Treatment 2[3]		Treatment 3[4]		Treatment 4[5]	
	Labor	Cost	Labor	Cost	Labor	Cost	Labor	Cost
Pull and tie plants	6.03	30.15	6.03	30.15	[6]4.81	24.05	....	....
Drive machine	....	....	....	....	....	....	.83	4.15
Fill bags, bins, or crates	.42	2.10	.42	2.10	....	....	1.66	8.30
Carry and load bags	.42	2.10	....	....	....	....	....	....
Carry and load crates	....	....	.42	2.10	.42	2.10	[7]1.66	8.30
Assemble crates	.51	2.55	.51	2.55	.51	2.55	.83	4.15
Disperse crates	....	....	.16	.80	.16	.80	[8].06	.30
Dump bags or bins	.50	2.50	....	....	....	....	....	....
Place bundles	.90	4.50	....	....	....	....	....	....
Crate plants and close	1.22	6.10	....	....	....	....	....	....
Weigh and count plants	....	....	....	....	.10	.50	.10	.50
Load crates on truck	.45	2.25	.45	2.25	.45	2.25	.45	2.25
Total	10.45	52.25	7.99	39.95	6.45	32.25	5.59	27.95

[1]An additional 25 percent has been added to the totals for the pulling operation to allow for personal time and fatigue. 20 percent is allowed for other operations. These totals do not include supervisory labor or labor marking crates. Wages are assumed at $3 per hour.

[2]Hand harvest, bundle, shed pack.

[3]Hand harvest, bundle, field pack.

[4]Hand harvest, field pack, loose.

[5]Machine harvest, field pack, loose.

[6]Includes pulling plants, packing, and closing crates.

[7]This labor consists of closing and stacking crates on a pallet, which, since it includes a large amount of idle time, could perhaps be handled by 1 man instead of 2.

[8]Placing empty crates on machine and removing pallets of filled crates from machine.

Table 8.—Cost of packaging materials, labor, and transport charges (dollars) per 1,000 plants, 1978-79

Item	Treatment 1[1]	Treatment 2[2]	Treatment 3[3]	Treatment 4[4]
Materials	0.861	0.861	0.745	0.745
Direct labor	.523	.400	.323	.280
Transport.....	1.320	1.320	1.200	1.200
Total.....	2.704	2.581	2.268	2.225

[1] Hand harvest, bundle, shed pack.
[2] Hand harvest, bundle, field pack.
[3] Hand harvest, field pack, loose.
[4] Machine harvest, field pack, loose.

Transport charges.—Trucks hauling plants from Georgia to northern producing areas are usually loaded to full cubic capacity because a fully loaded truck would seldom exceed legal weight limits.[4] Transport costs are charged on a per-crate basis, no matter how many plants are packed in a crate.

The average transport charge from Georgia to Ohio in 1979 was $1.32 per crate. It cost $1.32 per 1,000 bundled plants and $1.20 per 1,000 loose plants.

Total costs and charges.—Total costs and charges (excluding capital investment costs) to harvest, pack, and ship 1,000 plants were $2.70 for hand-harvested, bundled, shed-packed plants; $2.58 for hand-harvested, bundled, field-packed plants; $2.27 for hand-harvested, field-packed, loose plants; and $2.23 for the machine-harvested, field-packed, loose plants (table 8). Bundled, shed-packed plants cost more than bundled, field-packed plants because more labor was required. Field-packed, loose plants cost even less; material and labor costs and transport charges were less because more plants can be packed per crate. Machine-harvested, field-packed, loose plants cost least because the mechanical harvester does the pulling more efficiently than hand harvesting. If all 700 million plants were shipped loose and packed in the field, whether machine or hand harvested, the average savings could be 40 cents per 1,000 plants, a total annual savings of $280,000.

[4] Only when plants are harvested after rains and soil remains on the roots might weight be a problem.

RECOMMENDATIONS

Growers in the north generally preferred loose, field-packed plants because this method eliminates damage to plants caused by the string used to tie the bundles of plants and because the plants are easier to separate from each other. Those few growers who received machine-harvested, loose-packed plants believed these plants superior, even though they were harvested from the same fields as the plants treated otherwise. Generally, more machine-harvested plants survived transplanting than hand-harvested plants. The mechanical harvester causes less stem damage than the pullers, and machine-harvested plants usually have more roots intact.

The following rules should be followed to harvest, pack, and ship loose tomato transplants most economically:

1. Harvest and pack field-hardened plants of marketable size.
2. Harvest and pack plants when foliage is dry and the soil is not wet.
3. Be sure to remove (by shaking) as much soil as possible from the roots.
4. Do not underpack or overpack crates with plants. (Underpacking allows plants to move and get bent or broken; overpacking prevents plants from cooling properly in shipment and may cause them to heat during transit or storage.
5. Ship and store loose plants at 55° F for 10 days or less (combined time). If refrigerated storage space is not available, place wet burlap bags on

a barn floor, stack crates one layer high on the bags, and open crates.

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